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Electron scattering on the Hoyle state and carbon production in stars

M. Chernykh[1], H. P. Blok[2], H. Feldmeier[3], T. Neff[3], P. von Neumann-Cosel[1], A. Richter[1]

[1]*Institut für Kernphysik, Technische Universität Darmstadt, Germany*
[2]*Department of Physics and Astronomy, Vrije Universiteit, Amsterdam, The Netherlands*
[3]*Gesellschaft für Schwerionenforschung (GSI), Darmstadt, Germany*

Despite its astrophysical importance, the triple alpha reaction forming ^{12}C in stars is known with insufficient precision only [1]. It is essentially determined by the properties of the second 0^+ state, the so called Hoyle state, in ^{12}C. A large contribution to the uncertainty determining the 3α reaction rate comes from the partial pair width Γ_π for decay from the Hoyle state to the ground state in ^{12}C. In order to determine precisely the partial pair width, high-resolution inelastic electron scattering experiments were performed at the S-DALINAC. Results for the monopole matrix element (directly related to Γ_π) from a model-independent analysis based on an extrapolation of low-q data to zero momentum transfer are presented. Additionally, a Fourier-Bessel analysis of transition form factor is discussed. The electron scattering form factor also provides deeper insight into the internal structure of the Hoyle state predicted to be a dilute alpha gas with large spatial extension [2].

References

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Email-address: chernykh@ikp.tu-darmstadt.de